



MICROBIOLOGY

MICROBIAL STATUS OF GROUNDWATER IN AND AROUND CUDDALORE TOWN, TAMILNADU

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Abstract

Water is one of the abundantly available substances in nature. The groundwater is believed to be comparatively clean and free from pollution than surface water. But prolonged discharge of domestic sewage and industrial effluents causes the groundwater to become polluted and create health problems. Coliforms might cause intestinal disorders of the inhabitants and pilgrims. Ground water samples from 15 locations have been collected from Cuddalore Town including SIPCOT industrial area. The present study deals with the analysis of total Coliform count by most probable number (MPN) method and to identify the presence of gram negative or gram positive organisms. The bacteriological quality of groundwater had crossed the upper limits prescribed by WHO. The results found that the water in all these places was found to be unfit for human consumption due to contamination. Pollution control measures and strict enforcement of its laws have been recommended.

Key Words: Microbiological; Groundwater; Coliforms.

Introduction

Natural water (rivers, lakes, etc.) contains microorganisms but groundwater has fewer microorganisms than surface water because of its long travel time in the subsurface environment. Ground water in general is fresh and clean. Coliform bacteria is the most commonly associated with water quality [1]. Coliforms are defined as facultatively anaerobic, gram-negative, non-sporing, rod-shaped bacteria that ferment lactose with gas formation within 48 hours at 35°C. Coliforms, including *Escherichia coli*, are members of the family Enterobacteriaceae, which also includes *Enterobacter aerogenes* and *Klebsiella pneumoniae*. If such bacteria are not detectable in water in 100 ml, the water can be said as potable water. These bacteria makeup approximately 10% of the intestinal microorganisms of humans and other animals were found widespread used as indicator organism and also regarded as the faecal type of Coliform [2].

More than five million people die from water related diseases every year and about 50% population of the developing countries are exposed to polluted water resources[3]. Bacterial population is often considered as an important indicator of pollution. The total number of Coliform bacteria indicates the degree of pollution [4]. In

India, 80% of the infectious diseases are water-borne such as typhoid, cholera, dysentery and infectious hepatitis, which are due to contaminated water [5], [6]. Therefore, the present study was aimed to analyse the bacteriological properties of groundwater. In that area, the consumption of the groundwater may lead to many health hazards.

Materials and Methods

Samples of groundwater from various sites in Cuddalore Town including SIPCOT industrial area (Lat. 11° 43'N and Long. 79° 49' E on southeast coast of India) were collected and analysed for their bacterial content, in order to assess the microbial quality of groundwater. Fifteen groundwater samples were collected in pre-sterilized sampling bottles and were brought to the laboratory and analysed within 24 hour. The MPN of Coliforms was done by the following standard method [7]. [8], computed the MPN to evaluate coli-aerogenes tests by fermentation tube method. By referring to a MPN table (Table 1), a statistical range of the Coliform numbers is

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determined by observing the number of broth tubes producing gas.

Table 1. The MPN values of microbes in different sampling sites of Cuddalore Town

Sl.No.	Sampling Sites	MPN / 100 ml	<i>E. coli</i>	<i>Pseudomonas</i>	<i>S. albus</i>	<i>S. citrus</i>
1.	Poondiyankuppam	50	-	-	+	-
2.	Vairankuppam	56	-	-	-	+
3.	Sonanchavadi	132	-	+	+	-
4.	Semmankuppam	140	+	+	-	+
5.	Sangolikuppam	166	+	+	+	-
6.	Periyakaraikadu	161	++	-	+	-
7.	Chinnakaraikadu	161	+	-	-	+
8.	Vallikaraikadu	175	+	+	+	-
9.	Karaikadu	180	+	+	-	+
10.	Echankadu	182	++	+	+	+
11.	Kudikadu	180	++	+	-	-
12.	Pillayarmedu	132	++	+	-	+
13.	Pachayankuppam	103	-	-	+	-
14.	Cuddalore O.T.	9	-	-	-	+
15.	Thirupadiripuliyur	8	-	-	-	-

+ indicate the presence of lower level of microorganisms

++ indicate the presence of higher level of microorganisms

- indicate the absence of microorganisms

In the presumptive test tubes of the lactose medium were inoculated with 10, 1 and 0.1 ml aliquots of the water sample. The series consisted of at least 3 groups, each composed of five tubes of the specified medium and incubated for 24 hours. Development of gas in any of the tubes was presumptive evidence of the presence of Coliform bacteria in the sample.

The confirmed test required a selective and differential media, then positive lactose tubes and Eosin methylene blue agar (EMB) medium were used. The EMB medium contained the dye methylene blue, which inhibited the growth of gram-positive organisms. All plates were incubated for 48 hrs at 35°C. It produces dark centres and a green metallic sheen. This reaction was the characteristics for *E. coli*.

In the Completed test the purpose of the test is to determine whether the colonies growing on EMB plates are again capable of fermenting lactose and forming acid and gas and show the morphological appearance of Coliform groups. All the tubes were incubated for 48 hrs at 35°C. On microscopic examination, the presence of gram negative bacilli was confirmation of the presence of *E. coli* and they were indicative of a positive completed test.

Results and Discussion

The bacteriological analysis has a special significance in pollution studies, as it is a direct measurement of deleterious effects of pollution on human

health. Coliform is known as indicator bacteria, can be used as an indirect assessment of pathogenic bacteria and *E. coli* [9]. Coliform count performed by the most probable number (MPN) method (Table 2) is commonly used as the indicator for portability of water. In the present investigation microbial status of groundwater samples collected from different locations of Cuddalore Town are presented in Table 1. Maximum number of MPN value was found in the sampling site 10. In contrast, minimum number of MPN value were observed in the sampling sites 14 and 15. It may be due to the mixing of domestic sewage, industrial effluents and human activities. Since they are rich in organic matter, not only Coliform bacteria, but also other pathogenic bacteria can grow and multiply. The highest bacterial oviform contamination was observed in pre-monsoon period [10]. This results in the higher levels of bacterial contamination in water ecosystems, leads to various waterborne diseases [4].

Table 2. Most probable number (MPN) of Coliform microorganisms present in 100 ml of a water samples

Number of positive lactose broth tubes			Number of Coliform microorganism	Number of positive lactose broth tubes			Number of Coliform microorganism
10 ml	1 ml	0.1 ml		10 ml	1 ml	0.1 ml	
0	0	0	0	3	0	0	8.8
0	1	0	2	3	0	1	11
0	1	1	4	3	1	0	12
1	0	0	2.2	4	0	0	15
1	0	1	4	4	0	1	20
1	1	0	4.4	4	1	0	21
2	0	0	5	5	0	0	38
2	0	1	7	5	0	1	96
2	1	0	7.6	5	1	0	240

In this study, the contaminated organisms observed are *E. coli*, *Pseudomonas fluorescences*, *Staphylococcus albus*, *Staphylococcus citrus* and very few *Klebsiella pneumoniae* and *Enterobacter aerogenes*. Maximum *E. coli* content is observed in 9 sampling sites followed by *Pseudomonas*, *S. albus* and *S. citrus*. The MPN value for Coliform count is noted to be very high than the permissible limit of WHO in all the sampling sites except in the last 2 sampling sites. Bacteria are the most commonly used microbial tracers because they grow well in aqueous media and are easily detectable. The increase in microbial load is probably due to addition of untreated sewage, drainage and industrial wastes. Thus microorganisms have ample of nutrients and hence grow in abundance. This heavy load of microorganisms deplete the oxygen content. The effluent on percolation into the ground may pollute the water reservoir even though some amount of the organisms is filtered by the soil layers [11].

The Canadian maximum acceptable concentration of bacteria in the drinking water is 500 colonies/ml. The desirable limit of Coliform in water is 10 MPN/100 ml and *E. coli* count in 100 ml of any samples should be zero [12, 4]. The main reason for increased bacterial pollution is due to poor casing of borewells only upto 20-30 feet (6.10-9.15 m). The municipal corporation added disinfectants to the bore wells periodically to control bacteria [13]. The epidemic was mostly of cholera, dysentery, diarrhoea and gastro enteritis. For many decades cholera has continued to cause high epidemics in many parts of the world with high mortality rate [14].

Conclusion

On the basis of microbiological studies, it can be concluded that ground water in Cuddalore Town, nearly situated to an Industrial area are contaminated due to higher concentration of Coliform bacteria, which are greater than the WHO permissible limit and cause various health problems like gastro enteritis and urinary tract infections. The results of this study would greatly facilitate the health and sanitary authorities to monitor and control ground water pollution. Public awareness programmes on sanitation, its importance, simple and economical water treatment methods like filtration and boiling would prove beneficial to avoid waterborne diseases in the town. Groundwater used for drinking and cooking need to be pretreated to ensure prevention of health hazards.

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